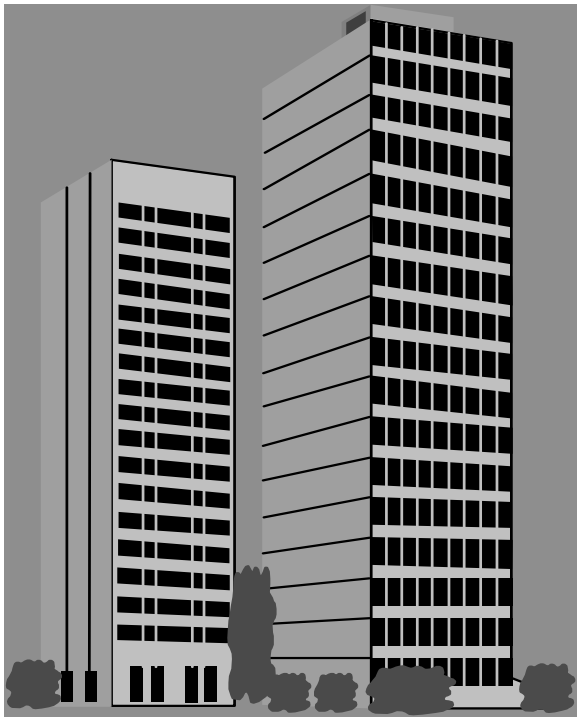
INDOOR AIR QUALITY ASSESSMENT

Department of Transitional Assistance
755 Main Street
Haverhill, Massachusetts



Prepared by:
Massachusetts Department of Public Health
Bureau of Environmental Health Assessment
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Background/Introduction

In response to a request from building occupants, an indoor air quality assessment was done at the Department of Transitional Assistance (DTA), 455 Main Street, Haverhill, Massachusetts. This assessment was conducted by the Massachusetts Department of Public Health (MDPH), Bureau of Environmental Health Assessment (BEHA). BEHA staff received complaints of eye and throat irritation as well as musty odors that occupants believed to be attributed to the building.

On April 18, 2000, a visit was made to this building by Cory Holmes, Environmental Analyst of the Emergency Response/Indoor Air Quality (ER/IAQ) Program. Mr. Holmes was accompanied by Suzan Donahue, Research Assistant, BEHA. The DTA leases space in a small plaza containing four storefront spaces. A health clinic and empty office space flank the DTA. A restaurant is located at the far west end of the building. The DTA occupies a space that contained a former liquor store that was renovated approximately five years ago. Several residences and a plumbing and heating business border the plaza to the West. A parking lot is located at the rear (South side) of the building.

Methods

Air tests for carbon dioxide were taken with the Telaire, Carbon Dioxide Monitor and tests for temperature and relative humidity were taken with the Mannix, TH Pen PTH8708 Thermo-Hygrometer. Screening for total volatile organic compounds (TVOCs) was conducted using an HNU Systems, Photo Ionization Detector (PID). Air tests for carbon monoxide (CO) and hydrogen sulfide (H_2S) were taken with the

Defender, Multi Gas Meter. Outdoor background TVOC and H_2S measurements were taken for comparison to indoor levels. Moisture content in random samplings was measured with a Delmhorst, BD-2000 Model, Moisture Detector with a Delmhorst Standard Probe. Moisture readings were conducted on ceiling tiles, carpeting and wallboard.

Results

The DTA has a maximum population of approximately 50-100 on a daily basis. The tests were taken under normal operating conditions. Test results appear in Tables 1-2. Air samples are listed in the tables by location that the air sample was taken.

Discussion

Ventilation

Carbon dioxide levels throughout the DTA were uniformly below the comfort guideline set by the BEHA for public buildings [i.e., greater than 800 parts per million parts of air (ppm) indicates a ventilation problem] (see Tables). These carbon dioxide levels are indicative of adequate air exchange by the mechanical ventilation system.

A heating, ventilation and air conditioning (HVAC) system provides ventilation. Fresh air is provided by rooftop-mounted air-handling units (AHUs) and distributed through ducted, ceiling vents located throughout the building (see Picture 1). Exhaust ventilation is provided by ceiling-mounted exhaust grilles, which return air to the AHUs (see Picture 2). This system was operating during the assessment. Restroom ventilation

is provided by ceiling-mounted local exhaust vents. These vents were not operating during the assessment.

In order to have proper ventilation with a mechanical supply and exhaust system, the systems must be balanced to provide an adequate amount of fresh air to the interior of a room while removing stale air. The date of the last servicing and balancing of the HVAC systems was not available at the time of the visit.

The Massachusetts Building Code requires a minimum ventilation rate of 20 cubic feet per minute (cfm) per occupant of fresh outside air or have openable windows in each room (SBBRS, 1997; BOCA, 1993). The ventilation must be on at all times that the room is occupied. Providing adequate fresh air ventilation with open windows and maintaining the temperature in the comfort range during the cold weather season is impractical. Mechanical ventilation is usually required to provide adequate fresh air ventilation.

Carbon dioxide is not a problem in and of itself. It is used as an indicator of the adequacy of the fresh air ventilation. As carbon dioxide levels rise, it indicates that the ventilating system is malfunctioning or the design occupancy of the room is being exceeded. When this happens a buildup of common indoor air pollutants can occur, leading to discomfort or health complaints. The Occupational Safety and Health Administration (OSHA) standard for carbon dioxide is 5,000 parts per million parts of air (ppm). Workers may be exposed to this level for 40 hours/week based on a time weighted average (OSHA, 1997).

The Department of Public Health uses a guideline of 800 ppm for publicly occupied buildings. A guideline of 600 ppm or less is preferred in schools due to the fact

that the majority of occupants are young and considered to be a more sensitive population in the evaluation of environmental health status. Inadequate ventilation and/or elevated temperatures are major causes of complaints such as respiratory, eye, nose and throat irritation, lethargy and headaches.

Temperature measurements ranged from 71° F to 75° F, which were within the BEHA recommended comfort range. The BEHA recommends that indoor air temperatures be maintained in a range of 70° F to 78° F in order to provide for the comfort of building occupants. A number of complaints of uneven heating and cooling were expressed to BEHA staff. In many cases concerning indoor air quality, fluctuations of temperature in occupied spaces are typically experienced, even in a building with an adequate fresh air supply.

The relative humidity in this building ranged from 23 to 33 percent, which is below the BEHA recommended comfort range. The BEHA recommends a comfort range of 40 to 60 percent for indoor air relative humidity. Relative humidity levels in the DTA would be expected to drop during the winter months due to heating. The sensation of dryness and irritation is common in a low relative humidity environment. Low relative humidity is a very common problem during the heating season in the northeast part of the United States.

Microbial/Moisture Concerns

Plants were noted in several areas. Plants can be a source of pollen and mold, which can be a respiratory irritant to some individuals. Plants should be properly maintained and be equipped with drip pans. Plants should also be located away from the air stream of mechanical ventilation to prevent aerosolization of dirt, pollen or mold.

Reports of musty odors to BEHA staff were concentrated to areas of the southeast corner of the building. Building occupants reported that the building had problems with water penetration both through roof leaks and along the southwest wall/floor junction. Reportedly a number of ceiling tiles were changed prior to the visit. The BEHA visit occurred on a moderately wet day following a week of substantial rainfall. If any active leaks were present, it would be expected that BEHA staff would find newly stained ceiling tiles and/or wet building materials (e.g., carpeting, wall board, etc.). No active leaks or stained ceiling tiles were noted.

BEHA staff also observed conditions in the ceiling plenum and measured moisture content in wallboard, carpeting and ceiling tiles. The ceiling plenum was dry, no signs of water penetration were observed and no unusual odors were detected. In addition, no measurable levels of moisture were noted in carpeting, ceiling tiles or wallboard.

A number of cracks in the exterior wall/foundation were noted along the West (residential) side of the building (see Pictures 3-4). While several of these cracks appeared to have been sealed with a caulking material, others were not. In some cases holes were noted in the waterproofing material. These conditions are breaches of the building envelope and can provide a means for water entry into the building. Repeated

water penetration can result in the chronic wetting of building materials and the potential for mold growth. The American Conference of Governmental Industrial Hygienists (ACGIH) recommends that carpeting be dried with fans and heating within 24 hours of becoming wet (ACGIH, 1989). If carpets are not dried within this time frame, mold growth may occur. Once mold has colonized porous materials, they are difficult to clean and should be removed.

Also noted on the residential side of the building were trees/stumps growing close to the foundation/exterior wall (see Pictures 5-6). The growth of roots against the exterior walls of the building can bring moisture in contact with wall brick and eventually lead to cracks and/or fissures in the foundation below ground level, which can breach the integrity of the building envelope and serve as a source of water penetration.

Other Concerns

Several conditions that can potentially affect indoor air quality were also identified. TVOCs within the building were found to be equal to or below levels measured outdoors in all areas surveyed. No measurable levels of CO or H_2S were measured in the building.

Floor drains were noted in restrooms (see Picture 7). Drains are designed with traps in order to prevent sewer odors/gases from penetrating into occupied spaces. When water enters a drain, the trap fills and forms a watertight seal. Without periodic input of water (e.g., every other day), traps can dry and compromise the integrity of the watertight seal. If traps dry out, sewer odors/gases can travel up the drain into occupied areas.

As previously mentioned, mechanical exhaust vents in restrooms were not operating at the time of the assessment. Several odor complaints were reported to BEHA staff. Exhaust ventilation is necessary in restrooms to remove moisture and to prevent restroom odors from penetrating into adjacent areas.

Located between the men and women's restrooms was an unvented custodial closet. An open container of germicidal detergent was noted on the sink in this area (see Picture 8). Also noted above the sink were missing/dislodged ceiling tiles (see Picture 9). Without mechanical exhaust ventilation odors from wet mops, cleaning supplies and other items can penetrate into adjacent areas (i.e., into the ceiling plenum through missing ceiling tiles).

Several photocopiers were noted in the DTA. Photocopiers can emit heat and odors. Photocopiers can also produce VOCs and ozone, particularly if the equipment is older and in frequent use. Ozone is a respiratory irritant (Schmidt Etkin, D., 1992). Photocopiers should be located in an area with adequate local exhaust ventilation to help reduce odors, pollutants and excess heat.

A pungent odor was noted in the rear storeroom adjacent to the parking lot exit. The source of this odor appears to be from cardboard boxes containing DTA records. The storage boxes were dry and appeared to be relatively new. Often times new cardboard materials and/or glues can emit odors. This area is not equipped with exhaust ventilation to help remove odors. It was reported that these items were stored in this area temporarily and are scheduled to be shipped out, which should eliminate the odor.

Conclusions/Recommendations

In view of the findings at the time of the visit, the following recommendations are made:

1. Continue to operate HVAC systems during periods of occupancy. Consider having the mechanical fresh air supply and exhaust balanced by an HVAC engineer.
2. Change filters for AHU equipment as per the manufacturer's instructions or more frequently if needed. Examine AHUs periodically for maintenance and function.
3. Restore/repair exhaust ventilation in restrooms to remove moisture and to prevent restroom odors from penetrating into adjacent areas.
4. Ensure all plants are equipped with drip pans. Examine drip pans periodically for mold growth and disinfect with an appropriate antimicrobial where necessary.
5. For buildings in New England, periods of low relative humidity during the winter are often unavoidable. Therefore, scrupulous cleaning practices should be adopted to minimize common indoor air contaminants whose irritant effects can be enhanced when the relative humidity is low. To control for dusts, a HEPA filter equipped vacuum cleaner in conjunction with wet wiping of all surfaces is recommended. Drinking water during the day can help ease some symptoms associated with a dry environment (throat and sinus irritations).
6. Repair and/or replace thermostats as necessary to maintain control of comfort.
7. Repair cracks on the exterior wall/foundation of the building to prevent water penetration.

8. Report any roof leaks or other signs of water penetration to building manager for prompt remediation.
9. Ensure photocopiers are located in a well-ventilated area.
10. Consider consulting a ventilation engineer concerning the installation of local mechanical exhaust ventilation in the custodial closet.
11. Replace missing/damaged-ceiling tiles.
12. Store chemicals and cleaning products properly.
13. Ensure water is poured into floor drains regularly to maintain the integrity of the traps.

References

ACGIH. 1989. Guidelines for the Assessment of Bioaerosols in the Indoor Environment. American Conference of Governmental Industrial Hygienists, Cincinnati, OH.

BOCA. 1993. The BOCA National Mechanical Code-1993. 8th ed. Building Officials & Code Administrators International, Inc., Country Club Hills, IL. M-308.1

OSHA. 1997. Limits for Air Contaminants. Occupational Safety and Health Administration. Code of Federal Regulations. 29 C.F.R. 1910.1000 Table Z-1-A.

SBBRS. 1997. Mechanical Ventilation. State Board of Building Regulations and Standards. Code of Massachusetts Regulations. 780 CMR 1209.0

Schmidt Etkin, D. 1992. Office Furnishings/Equipment & IAQ Health Impacts, Prevention & Mitigation. Cutter Information Corporation, Indoor Air Quality Update, Arlington, MA.

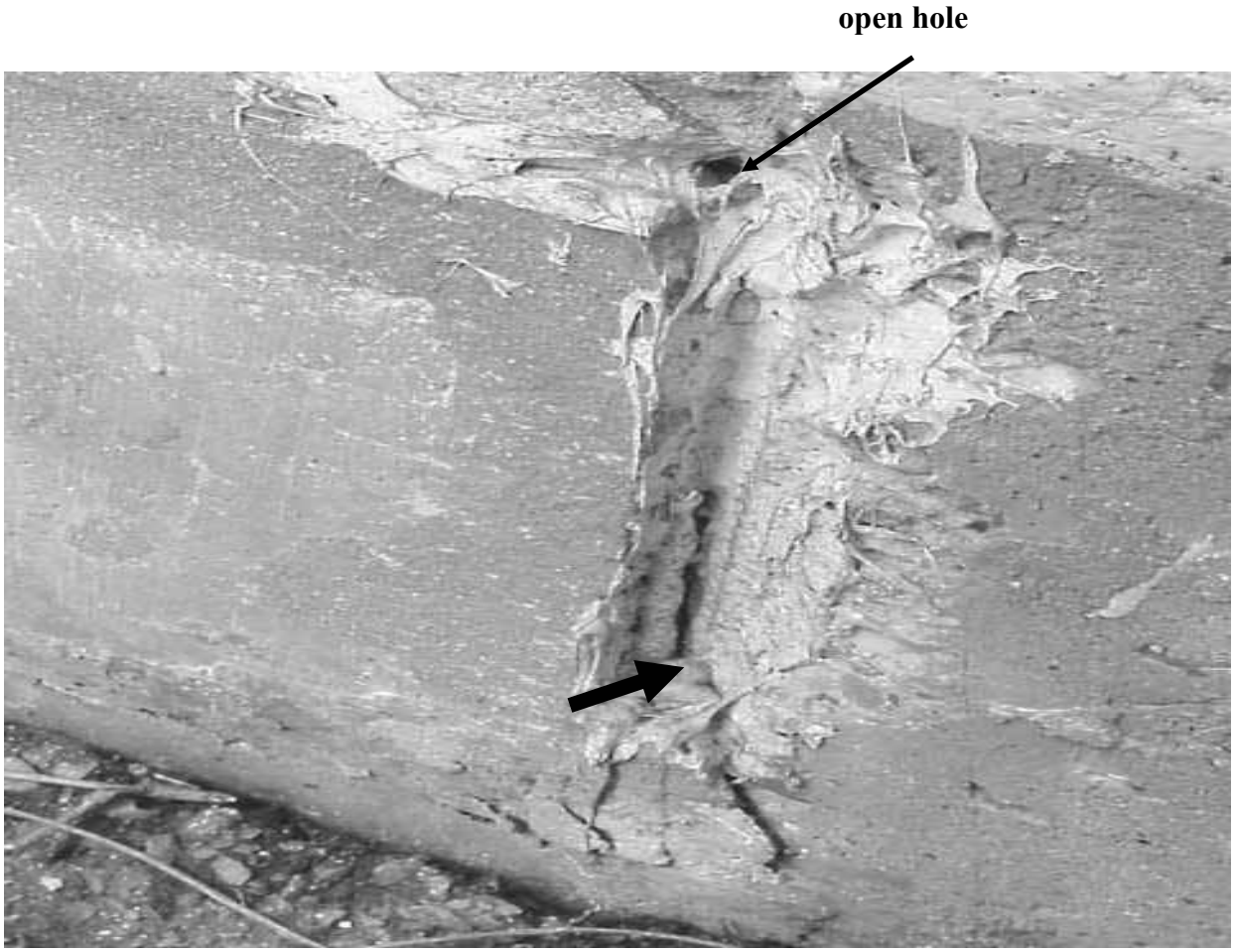
Picture 1

Ceiling-Mounted Air Diffusers Noted Throughout the Department of Transitional Assistance

Picture 2

Return Air Grate Noted throughout the Department of Transitional Assistance

Picture 3



Separation Noted in Exterior Wall/Foundation (Residential Side of Building) Note Holes and Spaces Despite Attempts to Seal

Picture 4

Separation Noted in Exterior Wall/Foundation (Residential Side)

Picture 5

Tree Growing near Foundation of Exterior Wall (Residential Side) Note Tree Roots Appear to be Growing Towards Building (as indicated by direction of arrow)

Picture 6

Tree Roots Noted near Foundation of Exterior Wall (Residential Side)

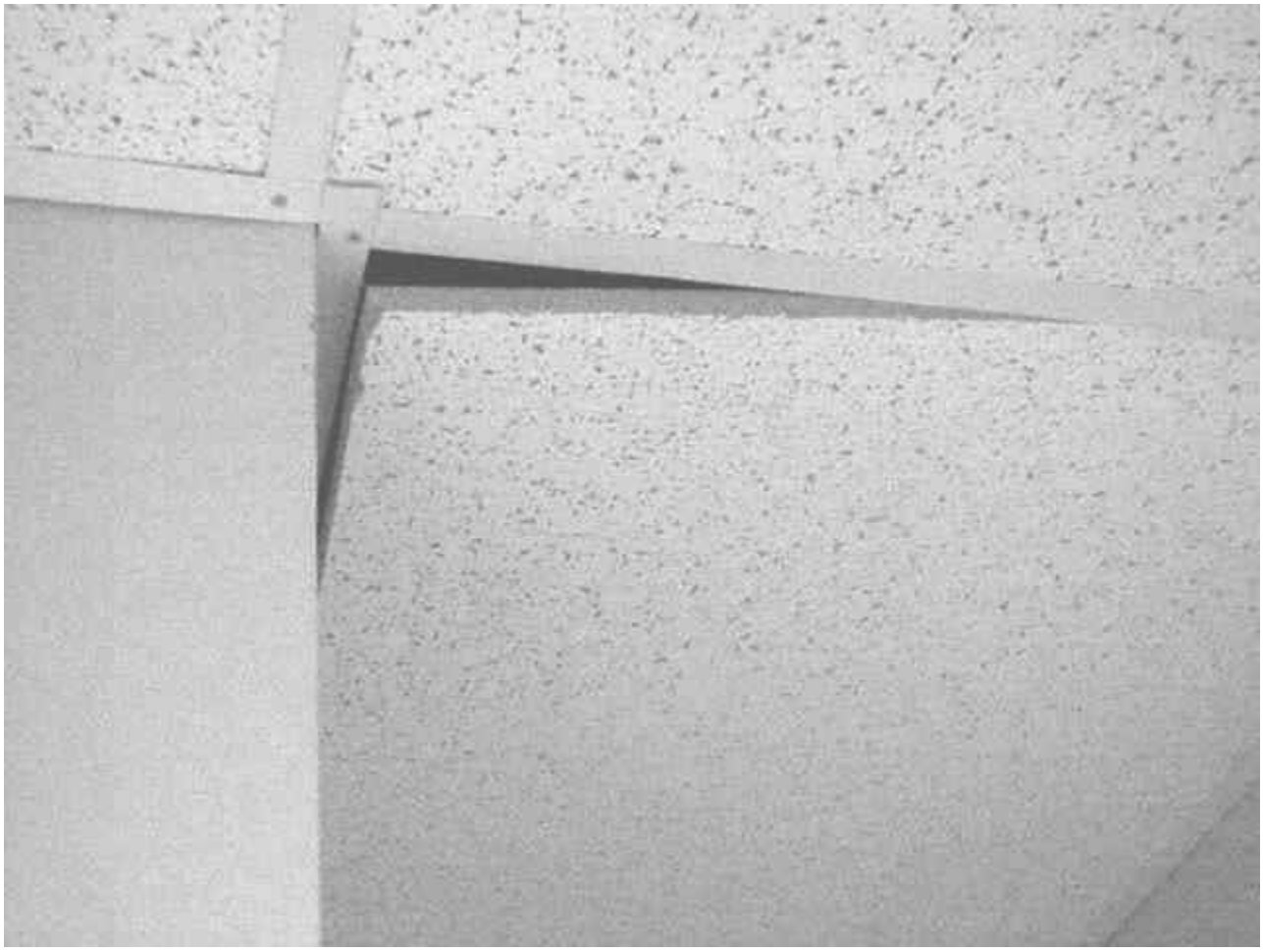
Picture 7

Floor Drain Noted in Restroom

Picture 8

Uncapped (1) Gallon Container of Germicidal Detergent Noted in Custodial Closet

Picture 9



Dislodged Ceiling Tile Noted in Custodial Closet

TABLE 1

Indoor Air Test Results –Department of Transitional Assistance, Haverhill, MA – April 18, 2000

Remarks	Carbon Dioxide *ppm	Temp. °F	Relative Humidity %	Occupants in Room	Windows Openable	Ventilation		Remarks
						Intake	Exhaust	
Outside (Background)	467	51	61					weather conditions: cool and overcast, NW wind 2-4 mph Total Volatile Organic Compounds (TVOCs)=0.3, Hydrogen Sulfide Gas (H_2S)=0, Carbon Monoxide (CO)=0
Women's Restroom					no	yes	yes	exhaust off/no draw, floor drain, strong odor-perfume
Cubicle 126 (5')	595	72	29	1	no	yes	no	dust complaints TVOCs=0.1, H_2S=0, CO=0
Cubicle Area 115/117 (5')	566	73	30	0	no	yes	yes	TVOCs=0.2, H_2S=0, CO=0
Cubicle Area 131/132 (5')	561	73	34	0	yes	yes	no	TVOCs=0.2, H_2S=0, CO=0
Cubicle Area 158/160 (5')	574	73	31	2	yes	yes	no	2 plants TVOCs=0.1, H_2S=0, CO=0
Cubicle 161 (7')	590	73	28	0	no	yes	yes	TVOCs=0.1, H_2S=0, CO=0
Custodian Closet							no	uncapped gallon of germicidal detergent
Rear Storeroom	553	69	28	0	no	yes	no	odor, carpeting near exterior door TVOCs=0.1, H_2S=0, CO=0

*** ppm = parts per million parts of air**
CT = water-damaged ceiling tiles

Comfort Guidelines

Carbon Dioxide -	< 600 ppm = preferred
	600 - 800 ppm = acceptable
	> 800 ppm = indicative of ventilation problems
Temperature -	70 - 78 °F
Relative Humidity -	40 - 60%

TABLE 2

Indoor Air Test Results –Department of Transitional Assistance, Haverhill, MA – April 18, 2000

Remarks	Carbon Dioxide *ppm	Temp. °F	Relative Humidity %	Occupants in Room	Windows Openable	Ventilation		Remarks
						Intake	Exhaust	
Supply Room	549	71	27	0	no	yes	yes	
Cubicle 140 (7')	540	74	33	1	no	yes	no	2 small plants, door open TVOCs=0.1, H_2S=0, CO=0
Cubicle Area 172/175	545	74	30	2	yes	yes	yes	5 plants TVOCs=0.2, H_2S=0, CO=0
Staff Room	544	74	26	0	yes	yes	yes	4 plants
Cubicle 145	549	74	27	1	yes	yes	no	photocopier, 3 plants
Cubicle 120	540	73	26	2	yes	no	no	
Director's Office	517	75	23	0	yes	yes	yes	TVOCs=0.1, H_2S=0, CO=0
Clerical Area	514	74	28	1	yes	yes	yes	exhaust off, photocopier
Reception Area	545	74	26	3	no	yes	yes	TVOCs=0.1, H_2S=0, CO=0

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